(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 913 814 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.05.1999 Bulletin 1999/18

(51) Int. Cl.[6]: **G11B 7/00**

(21) Application number: **98203486.0**

(22) Date of filing: **16.10.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **28.10.1997 US 959036**
18.06.1998 US 99616

(71) Applicant: **EASTMAN KODAK COMPANY**
Rochester, New York 14650 (US)

(72) Inventor:
Soscia, Peter P.,
c/o Eastman Kodak Company
Rochester, New York 14650-2201 (US)

(74) Representative:
Lewandowsky, Klaus, Dipl.-Ing. et al
Kodak Aktiengesellschaft,
Patentabteilung
70323 Stuttgart (DE)

(54) System and method for imprinting and reading a sound message on a greeting card

(57) Both a system and method for optically imprinting and reading sound data onto a piece of printed sheet material such as a greeting card (33) is provided. The system includes an encoding device (3) for converting a sound message into a two-dimensional encodement, a printer (31) for invisibly imprinting the encodement onto the greeting card, and a reader (65) for optically reading the encodement and converting it into a sound corresponding to the message. The encoding device preferably converts the sound message into a compressed digitized form prior to its ultimate conversion into a two-dimensional encodement. The reader preferably includes a lens (66) for focusing an image of the encodement onto the image sensor array. The sensor array responds to the image by generating a digital signal representative of the compressed sound that the reader decompresses and renders into an analog sound signal which is representative of the original sound image. Both the system and method are particularly useful in providing an individualized sound message on customized greeting cards.

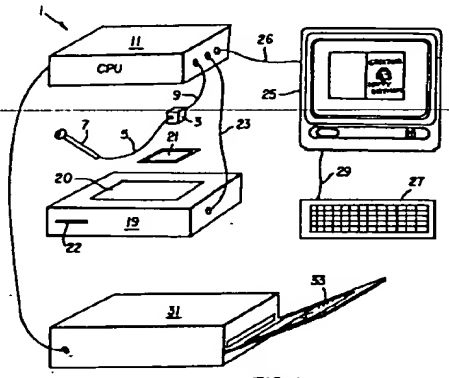

FIG. 1

EP 0 913 814 A2

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part of U.S. application Serial No. 08/959,036 filed October 28, 1997.

FIELD OF THE INVENTION

[0002] This invention generally relates to the imprinting and reading of sound data on a piece of printed sheet material, and is specifically concerned with the optical reading of an invisibly printed sound message on a greeting card.

BACKGROUND OF THE INVENTION

[0003] Techniques for incorporating sound messages into greeting cards are known in the prior art. An example of such a device is disclosed in U.S. patent 5,063,698. Here, the user records a message into a telephone answering machine which the vendor of the card then encodes into a small, battery operated playback device installed in the card. When the card is opened, a switch may be depressed to activate playback of the sound message. A similar recording and playback device for use in a postcard is disclosed in U.S. patent 4,791,741.

[0004] While such prior art techniques certainly enhance the personalization of a greeting card or postcard, they are accompanied by a number of drawbacks. First, despite ongoing progress in the miniaturisation of electronic components, such playback devices are relatively large and bulky relative to the sheet material that forms the card, and hence interfere with the aesthetics of the card by providing either an unsightly bulge or unwanted thickness along at least a portion of the card. To minimize the aesthetic intrusiveness of such modules, they are manufactured in as compact and lightweight a form as possible. However, the resulting small and lightweight structures of such modules necessarily limits the quality of the sound they produce, and renders them fragile and susceptible to breakage when conveyed through the various machinery of the postal service. Thirdly, the power cells used in such modules are likewise necessarily small and of limited power capacity, which in turn limits the module to a relatively short lifetime of operation.

[0005] It is also known to provide sound data on other forms of written or image bearing sheet material which is optically read by a hand-held device. For example, U.S. patent 3,970,803 discloses a system where a sound track is formed from a series of visible segments is printed over selected portions on the pages of a publication, such as a book. An optical scanner is provided which, when slid over the sound tracks, converts the sound track to sound. Similarly, French patent 2,494,873 discloses the use of a visibly printed bar code onto sheet music. A hand-held stylus-like decoder reads the bar code when swiped over it in order to produce sounds representative of the musical notes on the sheet music.

[0006] However, in both of these inventions, the conspicuous visibility of the printed sound track or bar code is not only unsightly, but visually distracting which is particularly problematical in the sheet music disclosed in the French '873 patent. While invisible inks are known, the necessary scanning motions that the system operator must execute in order to read the sound track or bar code necessitates that the printed representation of the sound data in these inventions be easily seen for proper alignment between the scanner and track or code. Finally, because of the required alignment between the sound track or bar code and the head of the scanning mechanism during the scanning movement, there is a possibility that the sound reproduction in either of these two prior art systems may be either unreliable or distorted due to inaccurate alignment.

[0007] It is also known to adhere a magnetic recording strip onto a photographic print for the storage of a sound message or commentary directly on the print. Such a system is disclosed in U.S. patent 4,270,853. However, such a system provides limited storage space and uses up available image space when placed on front of the print. Moving the magnetic strip to the back of the photographic print reduces its accessibility and makes it awkward to reproduce the sound while viewing the print. Moreover, this system requires a magnetic reader head that must be swiped along the longitudinal axis of the magnetic strip in accurate alignment therewith for the sound message to be played back with any degree or reliability and accuracy.

[0008] Clearly, there is a need for a technique for providing a personalized sound message on a greeting card, postcard, or other written message which does not rely upon electronic modules that create unwanted thicknesses in the card sheet material or unsightly bar codes or magnetic strips. Ideally, such a system would be capable of incorporating a high-quality sound recording directly on the surface of the card in an easy, inexpensive and visually unintrusive manner. The available message length should be as long as possible to accommodate sound messages of long duration. Finally, the system should allow for the playback of such a sound message in an easy and reliable manner which does not rely upon sweeping or scanning movements that must be critically aligned with a bar code or magnetic strip.

SUMMARY OF THE INVENTION

[0009] Generally speaking, the invention is a system and method for optically imprinting and reading sound data from a printed piece of sheet material, such as a greeting card that overcomes the shortcomings associ-

ated with the prior art. The system comprises an encoding device for converting a sound message into a two-dimensional encodement, a printer for invisibly imprinting the encodement onto a piece of sheet material, and a reader including an image sensor array for optically and remotely reading the encodement and converting it into sound corresponding to the message without the need for a swiping or scanning movement.

[0010] In an embodiment of the invention, the invention is a system for imprinting and reading sound data from a piece of printed sheet material, comprising an encoding device for converting a sound message into a two-dimensional encodement; a printer for printing said encodement onto a piece of sheet material, and a reader including an image sensor array for optically reading said encodement and converting it into sound corresponding to said message.

[0011] The encodement may be printed directly onto the printed sheet material, or onto a different, transparent sheet of material that is adhered or otherwise secured onto the printed sheet material. Where the piece of sheet material includes an imprinted image or design, the encodement may be invisibly integrated into such image or design. Such invisible integration allows the use of infrared dyes that would be faintly perceptible if printed against a blank, light background while still preventing the encodement from becoming a visual distraction on the greeting card or postcard that the system or method is applied to.

[0012] The encoding device preferably includes a digitizer for converting an analog sound system into digital data, a compressor circuit for compressing the digital sound data, and a circuit for rendering the compressed digital sound data into a two-dimensional encodement. The printer preferably imprints the two-dimensional encodement onto the piece of sheet material in a manner that is invisible to the human eye. The printer can either print the encodement onto the piece of printed sheet material, or onto another piece of sheet material (which may be transparent) which is subsequently secured onto the printed material. The reader may include a lens for focusing an image of the encodement onto the image sensor array to allow it to be remotely read. The image sensor array may be either a two-dimensional array or a combination of a linear array and a movable mirror which sweeps the focused encodement image across the array in such a manner as to obviate the need for a sweeping movement of the reader. The reader may also include a decompression circuit for converting digital data received by the image sensor into an analog sound signal representative of the original sound message, as well as a speaker for converting the analog sound signal back into sound.

[0013] The method of the invention includes the steps of recording a sound message, converting the sound message into a two-dimensional compressed encodement, invisibly imprinting the encodement onto a greeting card or a postcard or other written message, and then optically reading the encodement from the greeting card by focusing an image of the encodement onto an image sensor array. The image sensor array responds to the focused image by generating a compressed digital sound signal which is decompressed into an analog sound signal and converted into sound representative of the sound message.

[0014] The message recordation step may be implemented by remotely transmitting a sound message through any remote voice communication system, such as a telephone, radio, or internet. The message recorded may originate from a microphone, another recording device such as a tape recorder, or the sound recording of a camera having such a capacity, an audio CD or CD-ROM, or even a remote sound library. The method of the invention may further include the step of augmenting and editing the sound message prior to the conversion of an analog sound signal representative of the sound message into a compressed digital signal. The addition of such a step finds particular utility in a greeting card customizing kiosk, where the user might wish to mix sounds (such as background music) with a verbal message that is imprinted onto the greeting card or other type of communication.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Figure 1 is a schematic diagram of a greeting card printing station that includes an encoding circuit and a printer for invisibly printing a sound message onto a greeting card;

Figure 2 is a schematic diagram of the encoding circuit illustrated in Figure 1;

Figure 3 is a drawing of a greeting card produced by the printer illustrated in Figure 1;

Figures 4a and 4b are enlargements of image areas of the greeting card illustrated in Figure 3, illustrating how selected portions of the image area are invisibly encoded with a sound message;

Figure 5 illustrates how the sound encodement may be invisibly imprinted on a transparent sheet material which is subsequently secured onto a greeting card;

Figure 6 is a flow chart illustrating a method of operating the greeting card printing station illustrated in Figure 1 in order to generate the sound encoded greeting card illustrated in Figure 3;

Figure 7 is a blocked diagram of a circuit of a reader that optically reads the invisibly encoded sound message in the greeting card illustrated in Figure 3, and

Figure 8 is a perspective drawing of a hand-held arrangement of the optical reader of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0016] With reference now to Figures 1 and 2, wherein like numbers designate like components throughout all the several Figures, the sound encoding components of the invention may easily be integrated into a greeting card printing station 1. The station 1 may include a sound encoding circuit 3 having an input cable 5 connected to a microphone 7, and an output cable 9 connected to a central processing unit 11. The unit 11 may be, for example, any one of a number of PC-type computers.

[0017] With reference now to Figures 1 and 2, the sound encoding circuit 3 includes an analog to digital converter 13 for receiving an analog signal from the microphone 7 via cable 5 and for converting this signal into digital sound. Encoding circuit 3 further includes an audio compression module which reduces the amount of digital data required to represent the audio signal received from the microphone 7. Audio compression module 15 may be, for example, an AMBE-1000 Voice Coder manufactured by Digital Voice Systems, Inc. Such modules are capable of reducing the amount of data necessary to represent the analog signal received from the microphone 7 by about a 10 to 1 ratio. The encoding circuit 3 also includes an encoder 17 which translates the compressed digital data received by the audio compression module 15 into a two-dimensional data array such as, for example, AIM Standard PDF 417. Software and hardware for encoding and arranging the data according to such a standard is obtainable from Symbol Technologies, Inc., as part of a LS 49042D Scanner System. Another example is an encodement known as "Data Strip" available from Data Strip Corporation. An even more preferred encodement is commercially available under the trade name "Paper Disk" from Cobblestone Software, Inc. located in Lexington, Massachusetts. "Paper Disk" encodement is preferred due to its robustness; i.e., its scheme of providing redundant information at different locations within the encodement area. It is also preferred due to its ability to be optically decoded without error when skewed, i.e., when tilted at an angle of between 15 and 20° from perpendicular with respect to the center line of the lens used in the optical reader (described hereinafter).

[0018] Greeting card printing station 1 may also include an image scanner 19 of the type used in the "Kodak Image Magic Picture Maker" manufactured by Eastman Kodak located in Rochester, New York. Such an image scanner 19 includes a glass panel 20 where a photograph 21 may be supported for an image scanning operation. Scanner 19 also includes a slot 22 for receiving images from CD-ROM. While not specifically indicated in Figure 1, scanner 19 is also capable of receiving images from floppy discs, and rendering positive images from negative film. In all cases, the electronic circuits of the scanner 19 translate an image into a formatted scheme of digital data which is transmitted to the central processing unit 11 via a cable 23.

[0019] The greeting card printing station 1 further includes a display monitor 25 having a CRT tube in combination with the user keyboard 27 interconnected via a cable 29. The display monitor 25 displays all of the various formatting, print content, print font, and imaging options open to the operator of the printing station 1, as well as a precise representation of how these various visual options will appear on the final printed card. While the station 1 is illustrated as having a keyboard-type interface 27, it may optionally use a "touch screen" type interface. It should be noted that all of the various card editing options are stored in the memory of the CPU 11, whose output is connected to the display monitor 25 via a cable 26.

[0020] Finally, the greeting card printing station 1 includes a printer 31 for printing the final format of the card selected on the display monitor 25 onto an appropriate piece of sheet material. In the preferred embodiment, printer 31 may be an XLS 8650 digital color printer manufactured by the Eastman Kodak Company located in Rochester, New York. Such a printer is fully capable of not only rendering high quality color images with cyan, yellow, and magenta inks printed in a fine pixelated form, but is also capable of printing infrared dyes in the aforementioned encodement pattern which are completely or nearly invisible to the human eye.

[0021] Figures 3, 4a and 4b illustrate not only the sound-encoded greeting card produced by the station 1, but the manner in which the printer 31 imperceptibly prints the sound encodement onto the face of the card 33. Card 33 may includes image areas 33 generated by the photograph 21 or other image recording medium run through the scanner 19 of the greeting card printing station 1. Card 33 may further include design areas 37 is the form of artistic borders or other patterns that are selected by the system operator and printed on the card 33 to enhance appearance. Finally, the card 33 may have printed areas 39 carrying written greetings, messages, or other information selected by the user of the printer station 1. In the preferred embodiment, the sound message encodement is preferably printed in at least one of the various image, design, or printed areas 35, 37, and 39 as the darker portions of these areas provides a situs for the imperceptible printing of, for example, infrared inks.

[0022] Inks that are highly active in the infrared spectrum may include, as a principal component, an indium and tin mix oxide. While such inks are largely neutral with respect to visible light, they are not entirely so; many display a light yellowish green color that is distinctly visible to the naked eye, particularly when printed over a substantially white background. However, such inks may be imperceptibly integrated into the darker areas 40 in, for example, an image area 35, as is specifically shown in Figure 4b. Such an imperceptible printing may be accomplished by calculating, via the CPU

11, the precise contribution in terms of both color and overall visible light absorbency that the infrared ink will make on everyone of the selected group of pixels once it is overprinted thereon. Since a yellowish green color may be duplicated by the deposition of yellow and cyan inks, the CPU 11 first determines the exact amount of cyan and yellow density values that the overprinting of the infrared ink will apply to each of the pixels carrying audio data. After completing this step, the CPU 11 then calculates the cyan, magenta, and yellow densities for all of the pixels in the image file which are necessary to create the image in true color. In other words, the CPU 11 computes the precise number of cyan, magenta, and yellow density units that will have to be deposited onto each of the pixels in the image area 35 in order to obtain the proper "target" color for each pixel. After completing this step, the CPU 11 then subtracts the cyan, magenta, and yellow density units computed when determining the color contribution of the yellowish green infrared ink when the ink is overprinted onto the image area 35.

[0023] Once this step has been completed, the image area 35 will be printed in "true" color after the printer 31 prints all of the image pixels in cyan, magenta, and yellow dye, and then overprints the image area 35 with infrared ink since the CPU 11 now relies upon the light, yellowish green contribution of this ink to complete the image in "true" color. Since this process has the consequence of eliminating any visible contrast between the infrared dye and the image area 35, the encoded areas 41 printed onto the image area 35 by the infrared ink are completely imperceptible to the human eye. This particular aspect of the invention is explained in more detail in U.S. patent application 08/959,036 filed 28 October 1997 assigned to the Eastman Kodak Company, the entire specification and claims of which are incorporated herein by reference.

[0024] Figure 6 illustrates the method of operating the greeting card printing station illustrated in Figure 1. The method is initialized at the start step 45 by activating all of the components of the system. Next, the photograph 21 or other image is scanned by the scanner 19, as is indicated in step 47. This step results in the scanner 19 converting the image into a two-dimensional array of digital data, and transferring this data into the memory bank of the CPU 11. Next, the user of the system 1 selects, from the message, print font, and design choices displayed on the monitor 25, a format for the greeting card, as is indicated in step 49. In the next step of the method, the user commands the CPU to display a card bearing both the selected format and the image scanned by the scanner 19. The CPU responds by displaying a "rough draft" of the card onto the monitor as is indicated in step 51. In the next step 53, the user edits both the image and the format in accordance with the system options available. Such editing may involve the enlargement or reduction of the image, the vignetting of the image, the selection of different arrangements spacial between the image and the written greeting, etc. At the end of this step, the user selects a final format, as is indicated in step 55.

[0025] Next, the user selects the audio message which he or she wishes to invisibly print onto the card, as is indicated in step 57. Typically, this would involve recording a personalized message of a designated duration through the microphone 7. The limit of the message duration may be set, for example, at 10 seconds. As is indicated in step 59, the user then edits and augments the audio message. Step 59 may involve, for example, making the message longer or shorter, or adding other sounds to the message (such as background music) contained with a sound recordation data bank within the CPU 11. The user then selects the final version of the audio message, as is indicated at step 61. He then commands the printer 31 to print the final card 33, which contains the audio message in an invisibly printed form as previously described.

[0026] Figure 7 illustrates the optical reader component of the system of the invention which operates to optically scan the invisibly imprinted message in the greeting card 33, and to convert it into a sound message. To this end, the reader includes a lens assembly 66 for focusing an image of the invisibly imprinted encodement onto a two-dimensional sensor array 68 through a spectral filter 67 (which may be coated directly onto one of the surfaces of the lens assembly 66). The spectral filter is tuned to a wavelength that enhances contrast between the infrared dye and the background, whether the dye is absorptive or fluorescent. The image sensor array may be, for example, a video graphics array (VGA) sensor having a resolution of 640 by 480 pixels of a type well known in the art, or a higher resolution 16 mega pixel model KAF-6300 manufactured by the Eastman Kodak Company located in Rochester, New York. The use of a two-dimensional image sensor is preferred since it can capture the entire two-dimensional data array within the invisibly imprinted encodement without the user being required to move the reader in a scanning motion over the greeting card 33. The reader further comprises image sensor electronics 69, a memory 70, an image processor 71, a decoder circuit 73 which converts the two-dimensional array of data back into a digital data stream, a decompressor circuit 75 for decompressing the digital data stream back into a stream representative of the sound data prior to compression by the circuit 15 and a digital to analog converter 77 that converts the digital data stream received from the circuit 75 back into an analog sound signal. Finally, the reader includes a transducer/speaker circuit 78 which converts the analog signal into a sound representative of the originally recorded sound through the microphone 7. The reader circuit 65 is essentially the same as that described and claimed in commonly assigned U.S. patent application 08/931,575 filed September 16, 1997, the entire specification and claims of which are incorporated herein by reference.

[0027] Optionally, an auxiliary light source 79 may be

used in conjunction with the optical reader circuit 65 to enhance the sensitivity of the reader circuit 65 in reading the encodement on the greeting card 33.

[0028] Preferably the optical reader circuit 65 is battery operated and assembled within a cylindrical housing 80 so as to render the entire reader assembly 81 as easily portable as a common flashlight, as is shown in Figure 8.

[0029] While both the system and method of the invention have been described with respect to a specific embodiment, various additions and modification will become apparent to persons of ordinary skill in the art. For example, while the sound message may be non-perceptibly encoded into the image design or print areas of the card 33 by way of infrared inks, other invisibly or low visibility inks (i.e., ultraviolet or fluorescent) may be likewise used to implement such an encodement. Alternatively, the encodement may be visible, but "camouflaged" into aesthetic background designs in the greeting card. While the optical scanner assembly 81 is preferably portable, it may also be implemented in stationary form. While a two-dimensional image sensor array is preferred, the combination of a linear sensor array and pivotally movable mirror could likewise be used to create a reader assembly which is capable of "scanning" the image of the encodement without the need for a scanning movement on the part of the system user. All such variations, modification, and additions are included within the scope of this invention, which is limited only by the claims appended hereto.

Claims

1. A system for imprinting and reading sound data from a piece of printed sheet material (33), characterized by:

   an encoding device (3) for converting a sound message into a two-dimensional encodement;
   a printer (31) for printing said encodement onto a piece of sheet material, and
   a reader (65) including an image sensor array (68) for optically reading said encodement and converting it into sound corresponding to said message.

2. The system as defined in claim 1, wherein said sheet material that said encodement is printed on is said piece of printed sheet material.

3. The system as defined in claim 1, wherein said sheet material that said encodement is printed on is separate from said piece of printed sheet material.

4. The system as defined in claim 1, wherein said printer invisibly imprints said encodement onto said sheet material.

5. The system as defined in claim 1, wherein said encoding device includes a sound recorder (7) for recording said sound message.

6. The system as defined in claim 1, wherein said encoding device includes a digitizer circuit (77) for converting an analog sound signal into digital data.

7. The system as defined in claim 6, wherein said encoding device includes a compressor circuit (15) for compressing digital sound data.

8. The system as defined in claim 1, wherein said piece of printed sheet material is a greeting card (33).

9. The system as defined in claim 1, wherein said piece of printed sheet material is a postcard.

10. The system as defined in claim 1, wherein said two-dimensional encodement includes redundant data at different locations within said encodement for enhanced reading reliability.

11. The system as defined in claim 1, wherein said reader includes a lens (66) for focusing an image of said encodement onto said image sensor array for allowing said reader to read said encodement at a distance from said printed sheet material.

12. The system as defined in claim 11, wherein said image sensor array is one of a two-dimensional array or the combination of a linear array and a movable optical member for sweeping an image of said encodement over said linear array for allowing said reader to optically read said encodement from a stationary position with respect to said printed sheet material.

13. A method for imprinting and optically reading sound data from a piece of printed sheet material, characterized by the steps of:

   converting a sound message into a two-dimensional compressed encodement of said message;
   invisibly imprinting said encodement onto a piece of sheet material, and
   optically reading said encodement and converting said encodement into sound representative of said sound message.

14. The method as defined in claim 13, wherein said encodement is invisibly imprinted onto said piece of printed sheet material.

15. The method as defined in claim 13, further comprising the step of recording said sound message prior

to converting said message into a two-dimensional encodement.

16. The method as defined in claim 15, further comprising the step of augmenting and editing said recorded sound message prior to converting said message into a two-dimensional encodement.

17. The method as defined in claim 13, wherein said piece of printed sheet material is one of a greeting card and postcard.

18. The method as defined in claim 13, wherein said optical reading step includes the steps of focusing an image of said encodement onto an image sensor array to generate a compressed digital sound signal; decompressing said compressed digital sound signal into an analog sound signal, and converting said analog sound signal into sound.

EP 0 913 814 A2

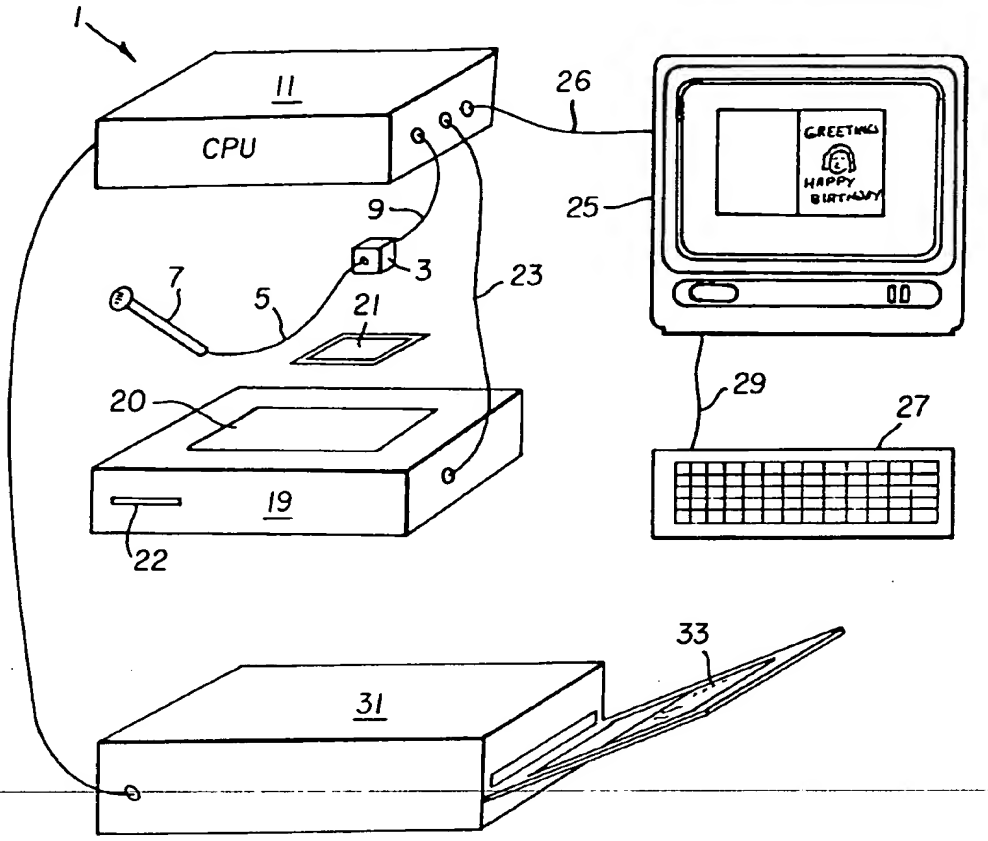

FIG. 1

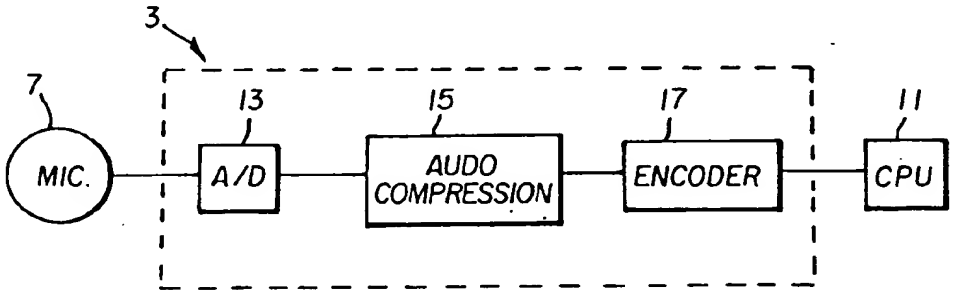

FIG. 2

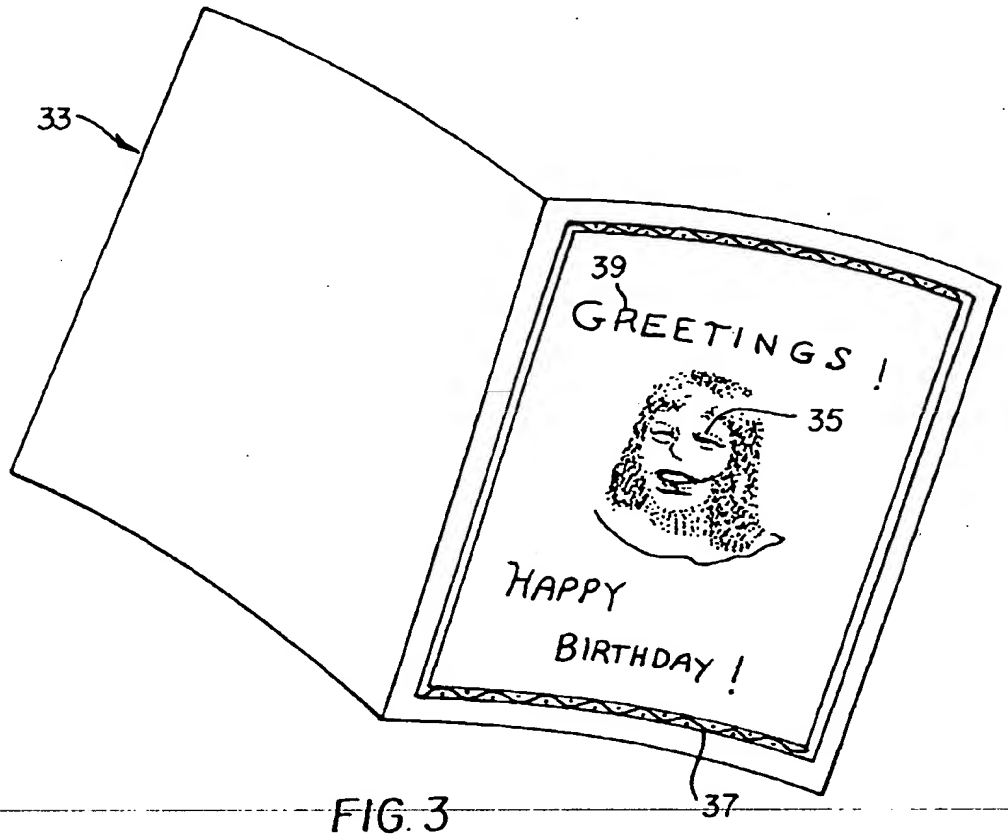
33
39
GREETINGS !
35
HAPPY
BIRTHDAY !
37

FIG. 3

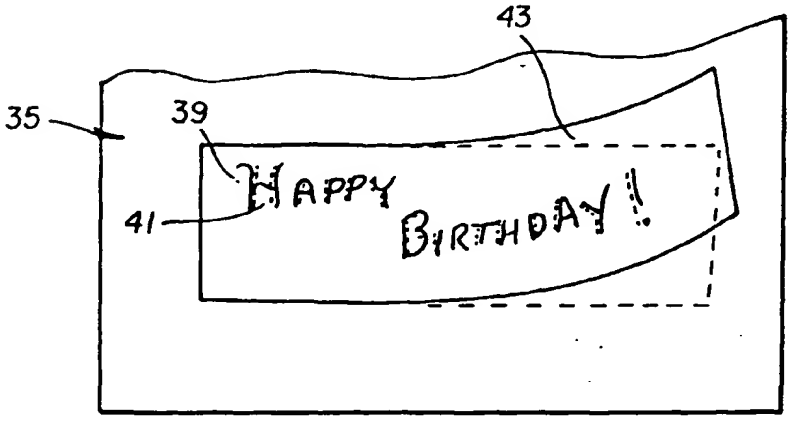
43
35
39
41
HAPPY
BIRTHDAY !

FIG. 5

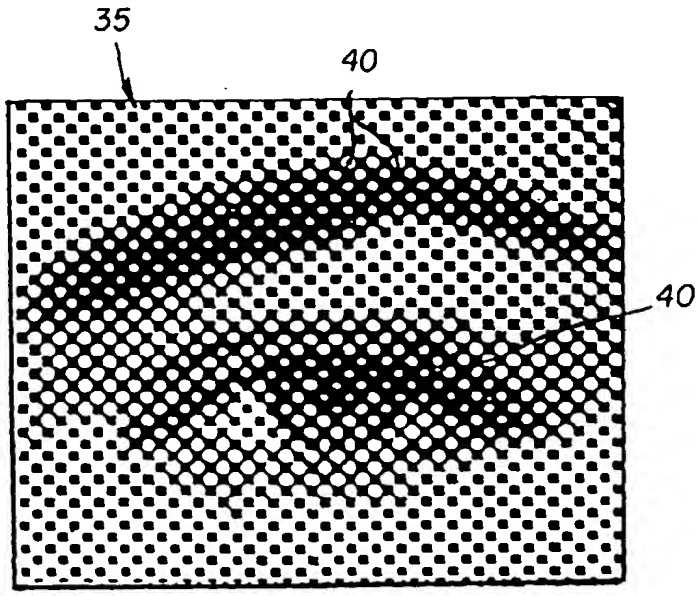

FIG. 4A

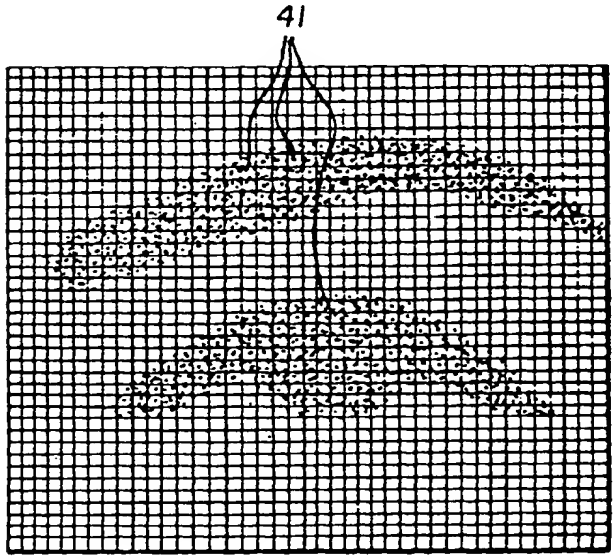

FIG. 4B

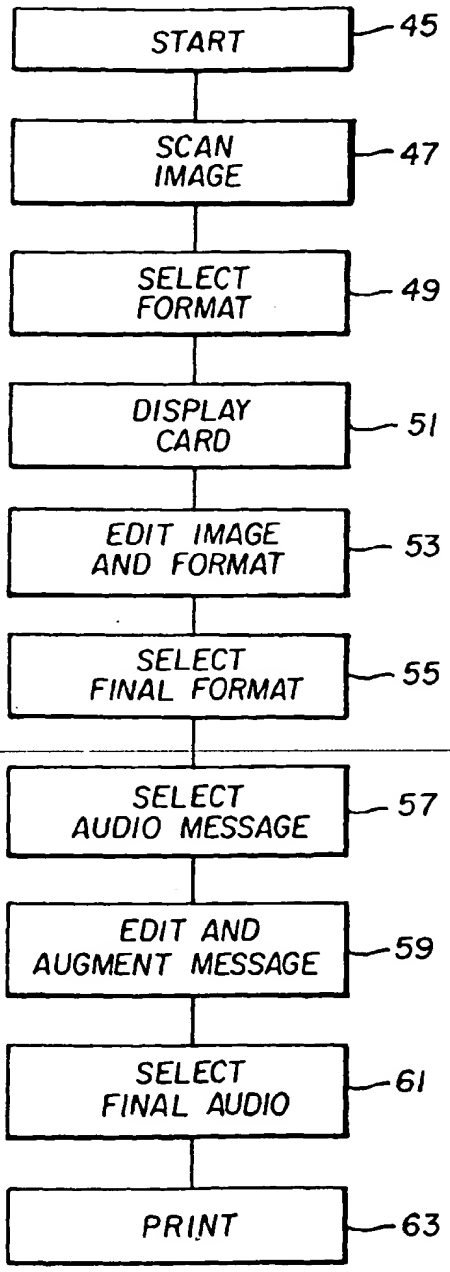
START
45
SCAN IMAGE
47
SELECT FORMAT
49
DISPLAY CARD
51
EDIT IMAGE AND FORMAT
53
SELECT FINAL FORMAT
55
SELECT AUDIO MESSAGE
57
EDIT AND AUGMENT MESSAGE
59
SELECT FINAL AUDIO
61
PRINT
63

FIG. 6

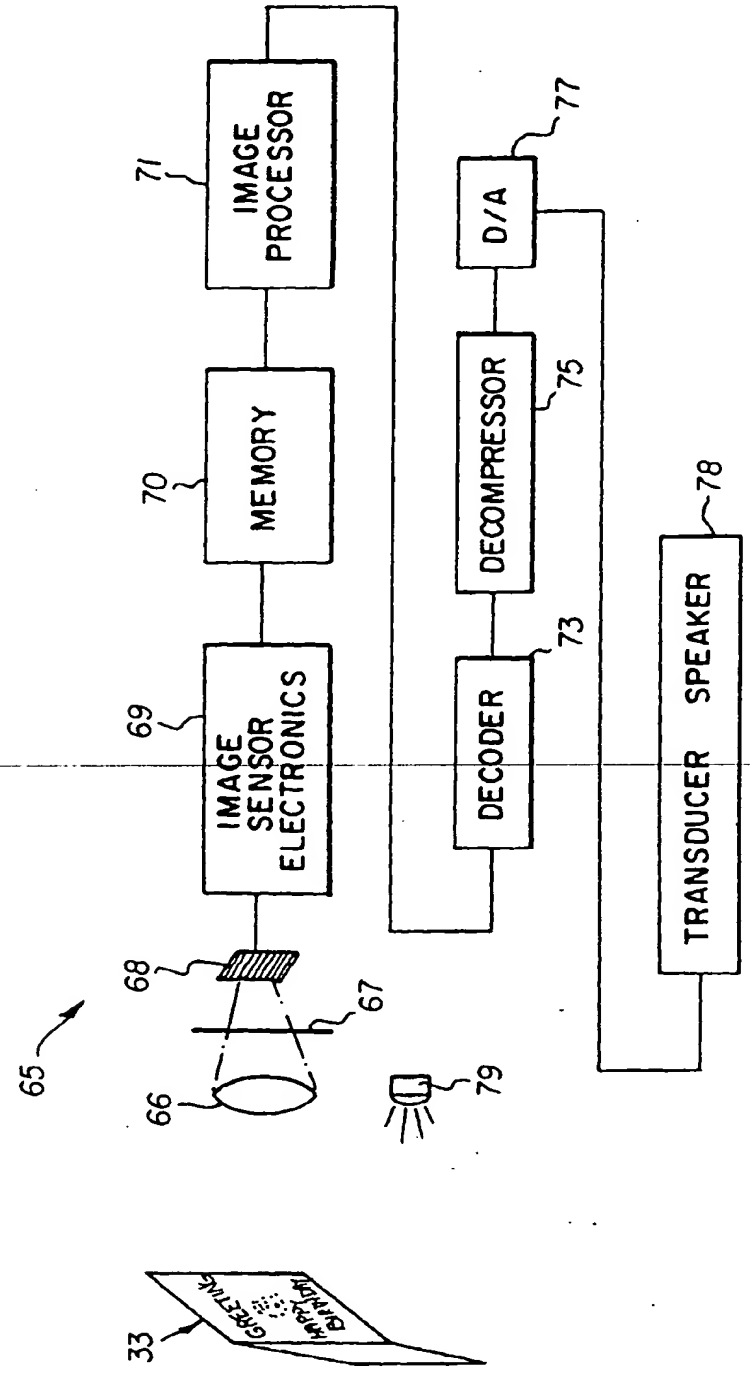
IMAGE PROCESSOR
71
MEMORY
70
IMAGE SENSOR ELECTRONICS
69
68
67
65
66
79
D/A
77
DECOMPRESSOR
75
DECODER
73
TRANSDUCER
SPEAKER
78
33

FIG. 7

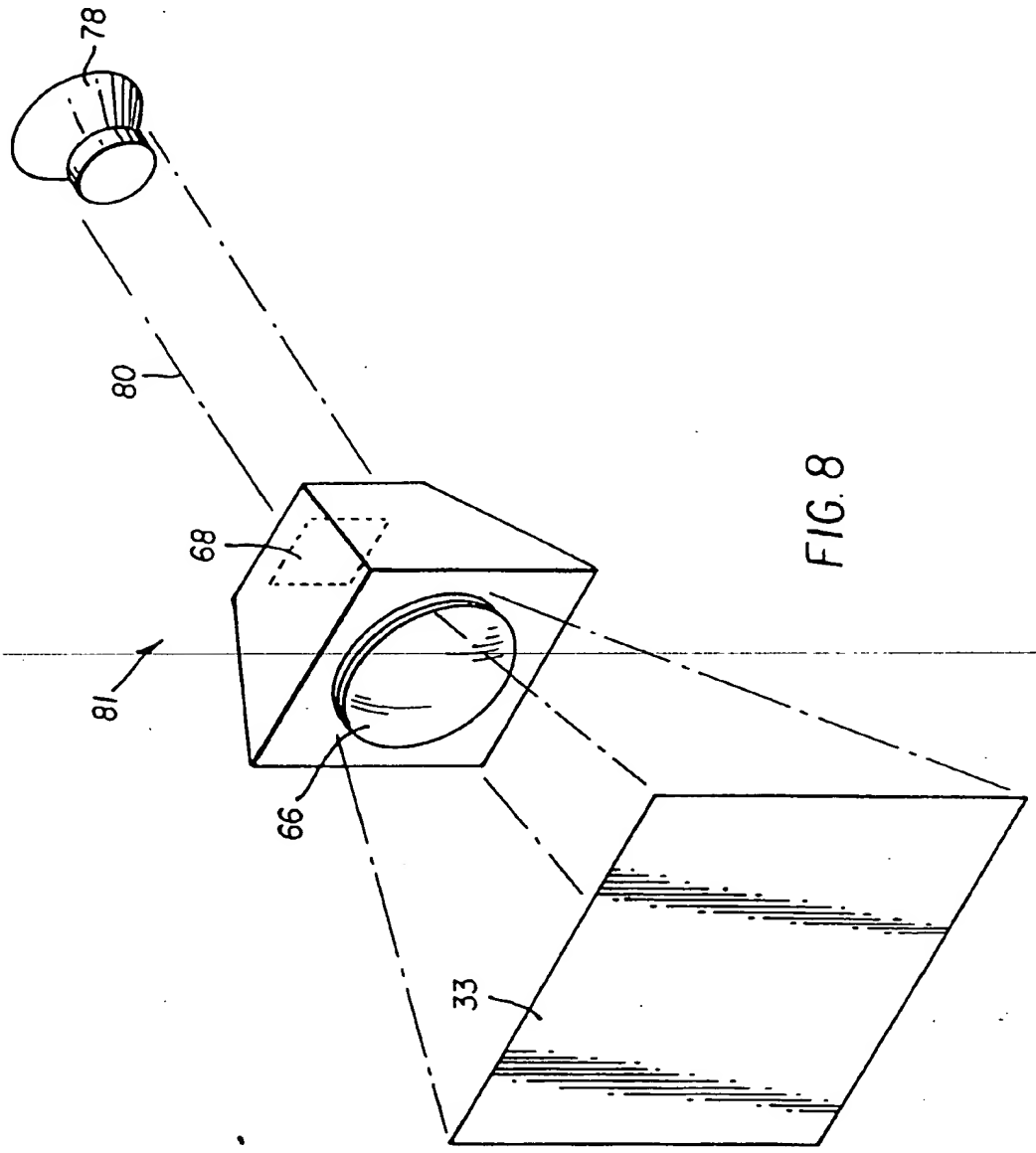

FIG. 8